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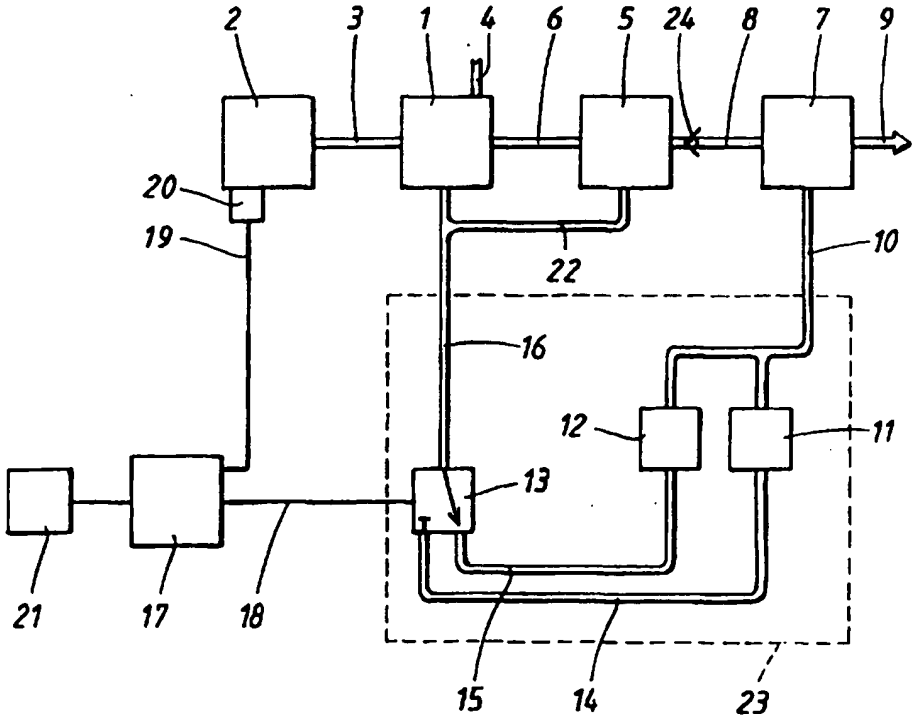
(54) Title: DEVICE AND METHOD FOR CONTROL OF AIR COMPRESSOR

(57) Abstract

The invention relates to a device for controlling an air compressor (1) in a motor vehicle, the engine (2) of which is arranged to power the air compressor (1), with compressed air being fed to at least one user (9), comprising a control unit (17) for the detection of a predetermined operational condition of the vehicle and for the control of the function of the air compressor (1). The invention is characterized in that it comprises first means (12) for the detection of a first predetermined pressure level (p_L) of said compressed air, and second means (11) for detecting a second predetermined pressure level (p_H) of the compressed air, with the second level (p_H) being higher than the first level (p_L), and with the control unit (17) and said means (11, 12) being arranged to deactivate the air compressor (1) at said second pressure level (p_H) in the case of said operational condition, and at said first pressure level (p_L) when said operational condition is not present. By means of the invention, an improved device is obtained for the control of the function of an air compressor, which permits a reduced amount of fuel in the engine, and which ensures that charging of air at a minimum air pressure always occurs.



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TITLE:

Device and method for control of air compressor.

TECHNICAL FIELD OF THE INVENTION:

The present invention relates to a device for the control of an air compressor, according to the preamble of appended claim 1. In particular, the invention can be applied in connection with motor vehicles which are equipped with an air compressor. The invention also relates to a method for the control of such an air compressor, according to the preamble of appended claim 7.

TECHNICAL BACKGROUND:

In connection with motor vehicles, in particular heavy commercial vehicles, the combustion engine of the vehicle is normally used to power various types of auxiliary devices, for example systems for air conditioning, generators and air compressors. As regards air compressors for commercial vehicles, these are normally used to provide various users of air in the vehicle, for example the brakes of the vehicle, the suspension system, and power-clutch, with pressurized air.

A known kind of air compressor system for vehicles comprises, with some simplification, an air compressor using which compressed air can be pumped to an air tank. From the air tank, pressurized air can then be provided to each of the air users, for example the brake-system of the vehicle. Furthermore, the stored air must be available in the air tank at a certain minimal air pressure in order to power the various users in a correct manner.

There is furthermore within the vehicle industry a general desire to reduce the fuel consumption of different vehicles as much as possible. In this context, it can be seen that the fuel consumption of a certain vehicle depends on the number of auxiliary devices which are connected to the

engine of the vehicle, and on the extent to which these auxiliary devices are powered. To use the combustion engine to power, for example, an air compressor, thus has a negative influence on the fuel consumption of the vehicle. This is a problem in connection with various kinds of vehicles, but in particular in connection with commercial vehicles in which air compressors are frequently used. The problem is particularly noticeable in vehicles with an air-driven suspension, which vehicles consume a large amount of pressurized air in order to raise the vehicles when loading and unloading cargo.

A system which focuses on the above-mentioned problem is known from EP 0335086. The system according to this document is arranged in a motor vehicle, in which a combustion engine is used to power a number of driving units, for example an air compressor which is arranged to fill an air tank. The system furthermore comprises a control unit which, depending on different operational parameters, can detect either "pull operation" (i.e. when the engine is driving the vehicle) or "push operation" (which is the case when the vehicle is driven without using the engine, which for example occurs when driving downhill). In this way, the air compressor can be powered depending on whether push operation occurs or not. This, in turn, causes the fuel consumption of the engine to be reduced since the air compressor in particular can then be activated during push operation, i.e. when the air compressor is driven by the kinetic energy of the vehicle rather than by its engine.

Although this previously known system controls the function of the compressor in a manner which permits a lower fuel consumption, it however has a significant drawback in that it cannot ensure that the air tank is always filled with air at a minimal air pressure. This is necessary in order

to, for example, ensure operation of the brakes of the vehicle, which of course is a necessity as regards the safety of the vehicle, and in order to provide sufficient lifting force for the air suspension of the vehicle.

SUMMARY OF THE INVENTION:

A main purpose of the present invention is thus to solve the above-mentioned problems, and to provide an improved device for the control of an air compressor arranged in a motor vehicle. This object is obtained by means of a device of the initially mentioned kind, the characteristics of which will become apparent from claim 1. The said objective is also obtained by means of a method of the initially mentioned kind, the characteristics of which will become evident from claim 7.

The invention is in particular intended for the control of an air compressor in a motor vehicle, and especially comprises a control unit for the detection of a predetermined operational state of the vehicle, and for the control of the function of the air compressor. This operational state is preferably a state where, in principle, no fuel is consumed in order to power the air compressor. The invention is based on the basic principle that it comprises a first means for the detection of a first predetermined pressure level of said compressed air, and a second means for the detection of a second predetermined pressure level of the compressed air, with the second level being higher than the first level. The control unit and said means are arranged to deactivate the air compressor at said second pressure level in the case of said operational state, and at said first pressure level in the case where said operational state is not present. This thus means that the air compressor will be powered up to said second pressure level in the case of said operational state, and that the air compressor will be powered up to

said first pressure level in the case where said operational state is not present.

By means of the invention, an efficient and simple control of the function of the air compressor is provided, which permits the air compressor to be powered up to the higher pressure level during those operational states during which the engine of the vehicle in principle does not require any fuel (which for example is the case when driving downhill). This in turn brings about a reduced fuel consumption of the engine.

An advantage of the invention is that the detection of the pressure levels takes place independently of the function of the control unit. In this way, activation of the air compressor is ensured up to a certain minimal pressure (i.e. the above-mentioned first pressure level) even if there is a malfunction of the control unit.

The invention is a simple solution to the problem of ensuring a lowest permitted air pressure in the air tank, since it uses two pressure regulators which detect one pressure level each. The invention furthermore comprises a controllable vent, by means of which an active air signal can be fed to the air compressor via either of the two pressure regulators when the air compressor is to be deactivated.

Further advantageous embodiments of the invention will become apparent from the appended dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS:

The invention will in the following be described in greater detail with reference to the appended drawing, which shows a schematic diagram of a system according to the present invention.

PREFERRED EMBODIMENT:

Fig. 1 shows a device according to the present invention in the form of a simplified block diagram. The device is in particular, but not exclusively, intended to be utilized in connection with heavy commercial vehicles. In a preferred embodiment, it comprises an air compressor 1, which in a conventional manner is arranged in connection to a combustion engine 2, for example in the form of a diesel engine. The air compressor 1 is connected to the combustion engine 2 via a mechanical coupling 3, and comprises a feed line 4 for the supply of ambient air.

The air compressor 1 is arranged to generate compressed air during operation of the engine 2. This is as such previously known, and will not be described in detail here. The compressed air is fed to an air drier 5 via a conduit 6. The air drier 5 is arranged to dry the air which is fed to it, and consists of a conditioning equipment which as such is previously known, or can alternatively consist of a device for the addition of alcohol or the like. The compressed and dried air is subsequently fed to an air tank 7 via a further conduit 8. The air tank 7 is, in a manner which is not shown in detail, connected to one or more air consumers in the vehicle. This is indicated schematically with an arrow 9. Such air consumers are, for example, the brake system of the vehicle, the air suspension system and a power-clutch.

Via a further conduit 10, the air tank 7 is connected to two pressure sensitive regulators 11 and 12. The regulators 11, 12 are as such of a previously known kind, and the first regulator 11 is arranged to detect a pressure which corresponds to a relatively high pressure level p_H in the air tank 7. This pressure p_H, which for example can be in the order of 12,5 bar, corresponds to a pressure level in the air tank 7 which is necessary in order to ensure access

to a large amount of stored pressurized air, which for example is needed in connection with the manoeuvring of the platform of the vehicle when the vehicle is not moving. Furthermore, the second regulator 12 is arranged to detect a pressure which corresponds to a second relatively low pressure level p_L in the air tank 7. This pressure p_L, which for example can be in the order of 8,5 bar, corresponds to a minimal pressure level in the air tank 7 which is necessary in order to ensure operation in an adequate manner of those air users in the vehicle which are necessary for reasons of safety, for example the brakes of the vehicle and air suspension.

The regulators 11, 12 are connected to a controllable valve 13 via two further air conduits 14 and 15. The valve 13 can be set in one of two positions, with one of the conduits 14 or 15 being connected to a further conduit 16 on the output side of the valve 13. The function of the valve 13 can be controlled by means of a control unit 17, which for this purpose is connected to the valve 13 via an electrical connection 18. The control unit 17 is preferably the engine control unit of the vehicle, which among other things controls the fuel injection to the engine 1. For this purpose, the control unit 17 is, via a further electrical connection 19, connected to the injection device 20 of the engine 2.

A plurality of sensors (which are symbolically indicated with the reference numeral 21 in the figure) are connected in a conventional manner to the control unit 17 for the detection of various parameters regarding the operational state of the vehicle, for example the speed of the vehicle, rpm, throttle position, engine temperature, etc. In a conventional manner, the control unit 17 is arranged to compute, depending on the operational state, among other

things the necessary amount of fuel for the engine during operation of the same.

A basic principle of the invention is that the air compressor 1 must always be able to ensure that the minimum pressure p_L is present in the air tank 7 during operation. This is a demand as regards safety, since the operation of, for example the brakes of the vehicle, cannot be ensured at pressures which are lower than said minimum pressure p_L. During normal driving with a certain throttle position, the valve 13 is thus set so that the conduit 15, which connects the low pressure regulator 12 to the valve 13, is connected to the air compressor 1, i.e. as shown in the figure. During this operational state, the air compressor 1 is powered so that air is fed to the tank 7, but when the regulator 12 detects that its pressure limit p_L has been reached, it will be activated so that an air signal is fed to the air compressor 1. This causes the air compressor 1 to be deactivated, i.e. it ceases to pump compressed air using the engine 2. During further driving, the air compressor 1 thus will not be powered for the compression of air, which causes the fuel consumption of the engine 2 to be reduced as well, since it in this case does not need to produce energy to power the air compressor 1.

As has been shown above, the air compressor 1 is connected to an air drier 5. From the figure, it is also apparent that the output conduit 16 of the valve 13 is connected to the air drier 5 via a further conduit 22. When the air pressure has reached the threshold value p_L of the regulator 12, air will also be fed to the air drier 5 which causes it to "spit", i.e. be emptied of moisture.

From the above description, it will become apparent that the air compressor 1 is always powered during normal driving, so that a minimum pressure p_L is present in the

air tank 7. Furthermore, in accordance with the invention, the air compressor 1 can be powered so that it generates the higher air pressure p_H in the air tank 7 in the case of certain predetermined operational states. Such operational states generally comprise those situations which are present when the engine 2 of the vehicle does not need any fuel (for example when driving downhill), which means that no fuel is necessary in order to power the air compressor 1. During such operational states, the air compressor 1 can thus, according to the invention, be powered without negatively influencing the fuel consumption.

According to the embodiment, said operational state can be considered present when one of several predetermined conditions is fulfilled. A first such condition is that the speed v of the vehicle is less than a certain predetermined value v_1. This can be determined by the control unit 17 by means of a speed sensor 21 which is connected to the control unit 17.

A preferred value of this threshold value v_1 is 40 km/h, but other values are also possible. A second predetermined condition is present when the speed of the vehicle v is higher than said threshold value v_1, but where there is a certain low need for fuel in the engine 2. This low need for fuel preferably corresponds to no fuel being needed for the engine 2. This operational state can also be determined by the control unit 17, since it is arranged to determine the amount of fuel necessary for the engine 2. A condition of the vehicle which causes this low need for fuel normally corresponds to driving downhill.

When any of the above-mentioned conditions are fulfilled, the control unit 17 thus determines that there is an operational condition during which loading of the air compressor 1 to the higher pressure p_H can be permitted.

This causes the control unit 17 to switch the valve 13, so that the conduit 14 which connects the high pressure regulator 11 to the valve 13 is connected to the air compressor 1 via the outlet conduit 16 of the valve 13. In this manner, the air compressor 1 will be powered and feed air to the air tank 17 until the high pressure level p_H is detected by the high pressure regulator 11. When this occurs, a high pressure regulator 11 will feed an active air signal to the air compressor 1, which is then turned off similarly to that which has been described above. The deactivation as such of the air compressor 1 is brought about by the pressurized air, which enters the compressor 1, affecting a (not shown) valve mechanism so that the pumping of air is interrupted.

The conditions for operation of the air compressor 1 until the higher pressure p_H is reached are chosen so that a minimal fuel consumption takes place in order to supply energy to the air compressor 1. The conditions can be said to be fulfilled, for example, when driving downhill when no fuel needs to be supplied to the engine 2, and where instead the kinetic energy of the vehicle supplies the energy which powers the air compressor 1.

It can be noted that the control of the valve 13 by the control unit 17 and the activation of the regulators 11, 12 are completely independent of each other. This means, for example, that the compressor 1 will always be charged up to at least the lower pressure level p_L. This is an advantage as regards safety, since operation of, for example, the brakes of the vehicles will thus always be ensured. Furthermore, the air compressor 1 will always be powered, so that air at at least the lower pressure level p_L is supplied in case there is a malfunction of the control unit 17, for example if it switches the valve 13 to the wrong

position or when the vehicle is driven in such a way that the throttle is constantly used.

According to the preferred embodiment, the control unit is arranged so that there is a certain time delay before the valve 13 is switched to that position which corresponds to the higher pressure level p_H. This prevents the system from assuming the high pressure position during short periods of time when there is a very low need of fuel in the engine 2, which, for example, is the case when shifting gears. This time delay is preferably in the order of 2-5 seconds. Preferably, a corresponding time delay is also used for switching to the low pressure position of the valve 13.

Furthermore, the regulators 11, 12 are preferably arranged in such a manner that they exhibit a certain hysteresis when switching on and off at their respective pressure levels p_L, p_H. This means that the pressure level at which the regulator is switched on is somewhat higher than the pressure level at which the regulator is switched off. This decreases the risk of overly rapid switching on and off, which might lead to a non-smooth operation of the air compressor 1.

In an alterative embodiment, the two regulators 11, 12 and the valve 13 can consist of a single integrated valve device 23. This valve is in that case arranged in connection to the air tank 7, and is equipped with an outlet conduit 16 to the compressor 1 and the air drier 5, and is arranged to be controlled by the control unit 17 via the electrical connection 18.

In certain applications, it is not necessary to utilize a separate air drying device 5. If such a device is utilized, it can be of the so-called "line unloader" kind. Furthermore, the invention preferably comprises a nonreturn

valve 24, which is arranged on the output of the air drying device 5. The nonreturn valve 24 can be separately arranged along the conduit 8 (which can be the case if an air drier is not used), or be an integrated part of an air drier.

The invention is not limited to the described embodiments, but can be varied within the scope of the appended claims. For example, the control unit 17 can be an integrated part of the engine control system of the vehicle, or it can be a separate unit.

Furthermore, the above-mentioned valve 13 can consist of an electrically controllable valve, an air controlled valve, or any other kind which permits switching between different positions.

Finally, it should be noted that the invention can be used in various kinds of vehicles, for example commercial vehicles or buses.

CLAIMS:

1. Device for controlling an air compressor (1) in a motor vehicle, the engine (2) of which is arranged to power an air compressor (1), with compressed air being fed to at least one user (9), comprising a control unit (17) for detecting a predetermined operational condition of the vehicle and for controlling the function of the air compressor (1), c h a r a c t e r i z e d i n that it comprises first means (12) for detecting a first predetermined pressure level (p_L) of said compressed air, and second means (11) for detecting a second predetermined pressure level (p_H) of the compressed air, with the second level (p_H) being higher than the first level (p_L), and with the control unit (17) and said means (11, 12) being arranged to deactivate the air compressor (1) at said second pressure level (p_H) in the case of said operational condition, and at said first pressure level (p_L) when said operational condition is not present.

2. Device according to claim 1, c h a r a c t e r i z e d i n that the control unit (17) is connected to a valve device (23) which comprises a valve (13), which is arranged for said deactivation, in which case it assumes a first position in the case of said operational condition, and a second position when said operational condition is not present.

3. Device according to claim 1 or 2, c h a r a c t e r i z e d i n that said means (11, 12) are pressure regulators arranged in connection to an air tank (7) of the air compressor (1) and arranged to detect said first pressure (p_L) and said second pressure (p_H).

4. Device according to any of the previous claims, characterized in that the control unit (17) is connected to detectors (21) for detecting the operational status of the vehicle in order to determine whether said operational conditions are present.

5. Device according to claim 3 or 4, characterized in that said valve device (23) is arranged to deactivate the air compressor by means of an air signal via the respective pressure regulators (11, 12).

6. Device according to any of claims 3-5, characterized in that said valve (13) and said regulators (11, 12) are one integrated valve device (23).

7. Method for controlling an air compressor (1) in a motor vehicle, the engine (2) of which is arranged to power the air compressor (1), comprising

feeding compressed air to at least one user (9) in the vehicle,

detecting by means of a control unit (17) whether a predetermined operational condition of the vehicle is present, and

activating or deactivating the compressor (1) respectively, depending on said operational condition, characterized in that it comprises:

detecting a first predetermined pressure level (p_L) of said compressed air,

detecting a second predetermined pressure level (p_H) of said compressed air with the second level (p_H) being higher than the first level (p_L),

deactivating the air compressor (1) at said second level (p_H) if said operational condition is present, and

deactivating the air compressor (1) at said first level ($p_{l.}$) if said operational condition is not present.

8. Method according to claim 7, comprising measuring the speed (v) of the vehicle, characterized in that the control unit (17) indicates that said operational condition is present if said speed (v) falls below a certain threshold value (v_l).

9. Method according to claim 7, comprising measuring the speed (v) of the vehicle and detecting the amount of fuel necessary for the engine (2), characterized in that the control unit (17) indicates that said operational condition is present if said speed (v) exceeds a certain threshold value (v_l) and the amount of fuel necessary falls below a predetermined threshold value.

10. Method according to any of claims 7-9, characterized in that the activation and/or deactivation of said air compressor (1) takes place with a predetermined time delay.

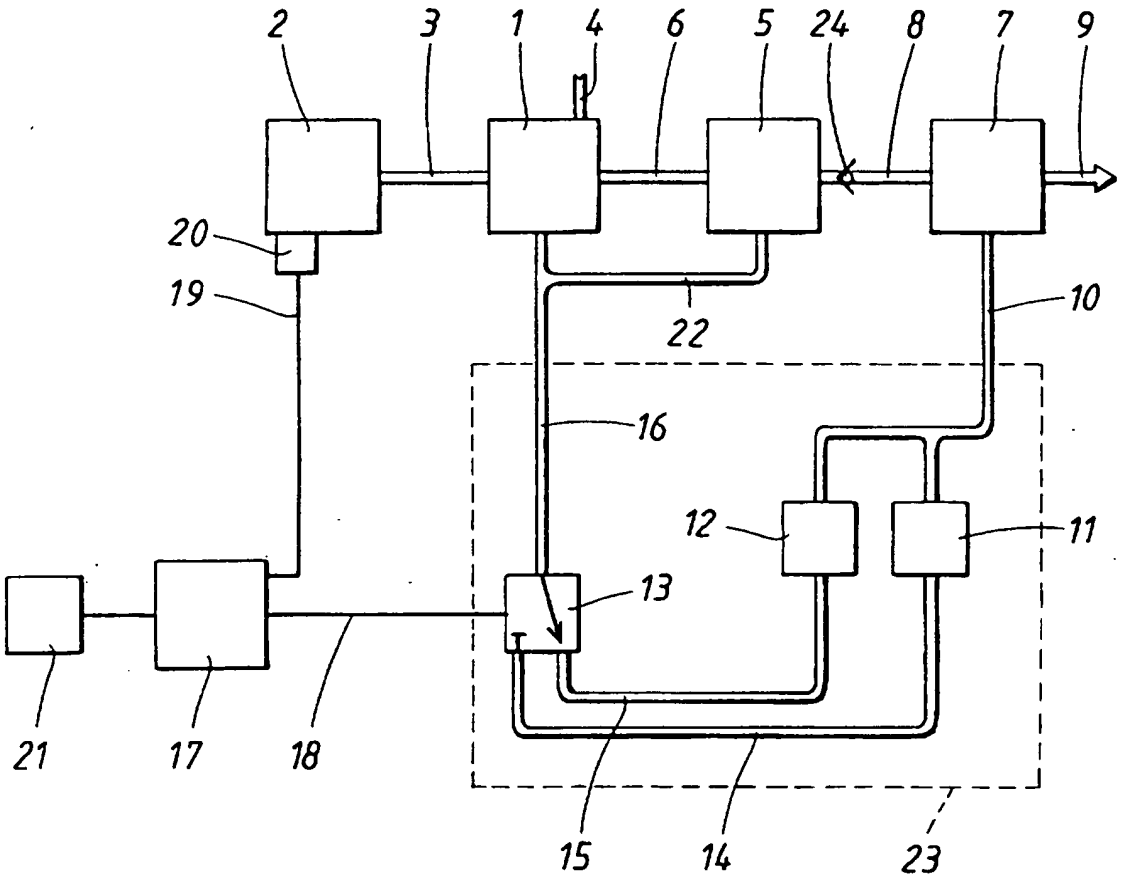

FIG. 1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 97/00728

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B60K 25/00, F02B 67/04
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B60K, F02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched.

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Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	WO 9105675 A1 (DOIG, ANDREW, JOHN ET AL), 2 May 1991 (02.05.91) -- --------	1-10

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INTERNATIONAL SEARCH REPORT

Information on patent family members

03/06/97

International application No.
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